POSITION/MOTION SENSOR

Cross-Reference to Related Applications

[0001] This application claims priority under 35 U.S.C. § 119 to provisional application Serial No. 60/228,223, which was filed on August 25, 2000. The disclosure of that application is hereby incorporated by reference.

Field of the Invention

[0002] The present invention relates to position and motion sensors and, more particularly, to position and/or motion sensors that may be employed in electronically controlled toys.

Background of the Invention

[0003] Various position sensors and devices that sense motion, which may be employed in an electronically controlled doll or toy, are known. It is common for position/motion sensors to employ spatially distributed electrical contacts, such as on the interior of a spherical or other spatial cavity. In such position/motion sensors, a freely movable contact is typically employed that moves about the cavity when the sensor is moved. Examples of various position and motion sensors are found in U.S. Patent Nos. 3,611,345, 4,496,836, 4,503,299, 4,751,353 and 4,766,275, the disclosures of which are herein incorporated by reference.

Summary of the Invention

[0004] The present invention includes a position/motion sensor, such as for use in an electronically controlled toy. The sensor has a housing that defines, in part, an annular track. A cylindrical contact roller is contained within the annular track. The roller indicates motion, or relative position, by electrically coupling electrical contact strips arranged adjacent to the annular track. The contact strips are typically included in a plate that is coupled with the housing. A circuit board, or boards, is also typically coupled with the plate and may transmit electrical signals to and from the contact strips to indicate motion or relative position of the sensor and, in turn, a toy in which such a sensor is employed. In two of the depicted embodiments, a position/motion sensor is included in a doll and a toy vehicle.

[0005] The advantages of the present invention will be understood more readily after a consideration of the drawings and the Detailed Description.

Brief Description of the Drawings

[0006] Fig. 1 is a drawing illustrating an exploded view of a position/motion sensor according to the present invention.

[0007] Fig. 2 is a drawing illustrating an isometric, partially sectioned, assembled view of the sensor illustrated in Fig. 1.

[0008] Figs. 3-5 are drawings illustrating the movement of a cylindrical contact within the sensor depicted in Figs. 1 and 2 as the sensor is rotated.

[0009] Figs. 6-9 are sectional drawings of the sensor depicted in Figs. 1 and 2 illustrating various electrical contact strip configurations.

[0010] Fig. 10 is a drawing illustrating an isometric view of an alternative position/motion sensor according to the present invention.

[0011] Fig. 11 is a drawing illustrating a top-side, exploded view of a housing, plate and contact of the sensor illustrated in Fig. 10.

[0012] Fig. 12 is a drawing illustrating an isometric assembled view of another alternative embodiment of a position/motion sensor according to the present invention.

[0013] Fig. 13 is a drawing illustrating a top-side, exploded view of a housing, plate and contact of the sensor illustrated in Fig. 12.

[0014] Fig. 14 is a drawing illustrating an embodiment of a doll according to the present invention.

[0015] Fig. 15 is a drawing illustrating an embodiment of a toy vehicle according to the present invention.

Detailed Description and Best Mode of the Invention

[0016] Referring initially to Figs. 1 and 2, an embodiment of a position/motion sensor is indicated at 10. Sensor 10 includes a housing 12, a cylindrical contact roller 14 that moves within housing 12 and a plate 16 that keeps roller 14 from falling out of housing 12. Sensor 10 also includes a circuit board 18 that may be coupled with plate 16. Pairs of contact strips 20 may be included with circuit board 18 and extend into housing 12 along an annular track 22, and roller 14 rolls within track 22 to make contact with various pairs of strips 20.

[0017] Annular track 22 preferably is bounded by an outer wall 24 and an inner wall 26, which may be formed as part of housing 12. Annular track 22 also may include one or more recesses 28 formed in outer wall 24, and one or more pairs of slots 30 formed in housing 12, each associated with a corresponding pair of contact strips 20. More particularly, a tab 32 may be formed as part of contact strips 20, and each tab 32 extends into a corresponding slot 30 to hold the distal end of each strip 30 in a fixed position relative to annular track 22 and the corresponding recess 28.

[0018] A proximal end of each contact strip 20 is attached to plate 16. For example, each contact strip 20 may include a tapered portion 34, and plate 16 may include a corresponding cutout 36 in which tapered portion 34 is held.

Alternatively, non-tapered contact strips 20 may be used. Preferably, contact strips 20 are held in place by being soldered to a corresponding circuit board trace 38, 40 or 42.

[0019] Contact strips 20 may be coupled electrically with an electronic device (not shown) via common wires 44 and 46, and jumper wire 48. More specifically, one contact strip 20 of each pair is electrically coupled with common wire 44 via traces 38 and 40; and jumper wire 48. Likewise, a second contact strip 20 of each pair is electrically coupled with common wire 46 via trace 42.

[0020] Roller 14 preferably rolls within housing 12 along annular track 22, to complete various electrical circuits in particular positions within annular track 22 by electrically coupling pairs of contact strips 20. Only a single digital output is possible with the embodiment shown in Figs. 1 and 2, because pairs of contact strips 20 are electrically coupled to common wires 44 and 46. This embodiment may be used to sense motion as completion of an electric circuit by roller 14, but it does not provide any output corresponding to the location of roller 14 within housing 12 other than an indication that roller 14 is in contact with one pair of contact strips 20.

[0021] Preferably, housing 12 and plate 16 include features that are shaped to cooperate and ensure proper alignment of those components as well as the alignment of contact strips 20 along annular track 22. For example, housing 12

may define one or more protuberances 50 and a receptacle 52, which may mate, respectively, with notches 54 and post 56 included in plate 16. The portion of plate 16 that defines post 56 may also define a mounting hole 58. Mounting hole 58 may be used to couple sensor 10 with an electronically controlled toy, as will be discussed below.

[0022] One final detail to be discussed with respect to Figs. 1 and 2 is found on the surface of roller 14, in the form of helical grooves 60. Grooves 60 preferably include associated ridges that may improve the electrical connection that roller 14 makes with contact strips 20 as compared to a roller having a smooth surface. Therefore, grooves 60 may improve the overall performance of sensor 10.

[0023] Referring now to Figs. 3-5, travel of cylindrical roller 14 along annular track 22 as sensor 10 is rotated is depicted. It should be noted that sensor 10 would typically be oriented such that gravitational forces act on roller 14 to move it within annular track 22. For example, roller 14 is shown in Fig. 3 at the lowermost portion of housing 12, where it would fall under the forces of gravity.

[0024] Fig. 4 depicts sensor 10 rotated clockwise from the position in Fig. 3. Roller 14 rolls along annular track 22 to stay near the lowermost portion of housing 12, to a position between a first pair and a second pair of contact strips 20. Fig. 5 depicts sensor 10 rotated further clockwise from the position in Fig. 4, in

which roller 14 has rolled to electrically couple the second pair of contact strips 20.

[0025] Various configurations for contact strips 20 may be employed with position/motion sensors according to the invention. For example, Fig. 6 shows in detail a pair of contact strips 20 within recess 28, as has been previously discussed. Such a configuration results in the surfaces of contact strips 20 facing annular track 22 being substantially flush with the non-recessed portions of outer wall 24. In such a situation, roller 14 may move within annular track 22 with relatively low mechanical resistance.

[0026] One alternative contact configuration is shown in Fig. 7, in which outer wall 24 has no recesses. For this configuration, contact strips 20 are positioned inside outer wall 24, and some measure of mechanical resistance will be affected by contact strips 20 as roller 14 moves within annular track 22. This mechanical resistance may influence the amount of angular rotation employed to electrically couple the pairs of contact strips 20 via roller 14 in such embodiments. The angular dwell of cylindrical contact 14 within such pairs may also be affected by such a configuration. In this context, angular dwell may be defined as the angular rotation employed from the point where roller 14 electrically couples a pair of contact strips 20, until the point roller 14 electrically decouples from that pair.

[0027] Another alternative contact configuration is shown in Figs. 8 and 9, in which the pairs of contact strips 20 are sloped relative to one another. Each pair of contact strips 20 in such an embodiment may form a 'v' shape. Such an orientation may affect the angular dwell of roller 14 within such a pair. Typically, angular dwell would increase relative to non-sloped contact strips, as sloped contact strips 20 would cradle roller 14 when electrically coupling such a pair. This cradling may, in turn, increase the angular rotation, e.g. angular dwell, employed to electrically decouple roller 14 from a sloped pair of contact strips 20.

[0028] Referring now to Figs. 10 and 11, an alternative embodiment of a position/motion sensor is indicated at 110. Sensor 110 includes basic components that are similar to those discussed with respect to sensor 10. For example, sensor 110 includes housing 112, cylindrical contact roller 114 and plate 116, where roller 114 is shown outside housing 112.

[0029] It is noted that the 100-series reference numbers for the elements numbered 112-158 of sensor 110 correspond to the reference numbers 12-58 of sensor 10 for analogous features. For example, housing 112 corresponds with housing 12. These features will not be described in detail again with respect to sensor 110. Furthermore, any of the configurations for contact strips 20 shown in the drawings may be used for this and other embodiments of the invented position/motion sensor.

[0030] One aspect of sensor 110 that distinguishes it from sensor 10 is the use of multiple circuit boards 162, 164 and 166 that may be coupled with plate 116. The use of multiple circuit boards may reduce cost as the total amount of material used may be reduced as opposed to using a single circuit board. Likewise, the use of multiple circuit boards may reduce the need for more than one layer of circuit boards traces, which may also reduce overall cost.

[0031] Another aspect of interest for sensor 110 is that one contact strip 120 of each pair of contact strips 120 is electrically coupled with an individual wire such as one of wires 170, 172, 174 or 176, and is not electrically coupled with contact strips 120 of any other pair of contact strips 120. This allows this embodiment be used to sense position, and not just motion, because roller 114 may complete one of a separate electrical circuit via one of individual wires 170-176 along with common wire 144. Thus, embodiment 110 may provide four different digital output signals corresponding to the location of roller 114 within housing 112.

[0032] Referring now to Figs. 12 and 13, another alternative position/motion sensor according to the present invention is indicated at 210. Sensor 210 includes basic components that are similar to those discussed with respect to sensors 10 and 110. The 200-series reference numbers used for the elements numbered 212-238 of sensor 210 correspond to the reference numbers

12-38 of sensor 10, and reference numbers 112-138 of sensor 110 for analogous features.

[0033] One notable difference of sensor 210 as compared to sensors 10 and 110 is the configuration of outer wall 224. Outer wall 224, while including recesses 228, as previously described, also may include one or more ramps 278. Ramps 278 may reduce the mechanical resistance roller 214 encounters when entering a pair of contact strips 220, as opposed to embodiments not including such ramps. Such a configuration may also affect the angular dwell of sensor 220, as roller 214 may enter a contact strip 220 pair more easily.

[0034] Another aspect of sensor 210 that differs from sensors 10 and 110 is the cooperative features for aligning its various components. In this regard, outer wall 224 may include pin-receiving holes 280 formed in outer wall 224 and/or in protrusions 282 included in outer wall 224. Preferably, pin receiving holes 280 mate with pins 284 included on plate 216 and/or protrusions 286 included with lid 216.

[0035] With regard to aligning contact strips 220, lid 216 may include slits 288 through which contact strips 220 may be inserted. Slits 288 typically cooperate with slots 230 in housing 212 for aligning contact strips 220 along annular track 222. Once the cooperative features discusses above are mated, housing 212, plate 216 and circuit board 218 may coupled using screw 290.

Screw 290 may be inserted through a hole (not shown) in circuit board 218, screw hole 292 in plate 216, and threaded into threaded hole 294, which may be formed along with inner wall 226. Of course, other techniques for coupling the various components of sensor 210 exist.

[0036] One final detail to be discussed with respect to Figs. 12 and 13 is the electrical connections included on circuit board 218. Circuit board 218 may include signal wires 296 and circuit board traces 238. Signal wires 296 and circuit board traces 238 may be configured to connect the contract strips 220 of sensor 210 to an electronic device (not shown) for sensing motion or position, as has been previously described. The present invention is, of course, not limited to the specific connection schemes described and many alternative connection configurations within the scope of the present invention exist.

[0037] Referring now to Figs. 14 and 15, two embodiments of toys according to the present invention are depicted. In Fig. 14, a doll according to the present invention is indicated at 300. Doll 300 includes position/motion sensor 310, which may be similar to those embodiments previously described, though the invention is not so limited. Doll 300 may employ sensor 310 to electronically control various functions, such as, for example, voice/sound generation or movement. Of course, other features of the doll may be affected by an indication

of motion or relative position as a result of electrical signals conveyed to and from sensor 310.

[0038] Referring to Fig. 15, a toy vehicle according to the present invention is indicated at 400. Vehicle 400 includes position/motion sensor 410. As with doll 300, sensor 410 may be used to electronically control various functions of vehicle 400. Such functions may include engine sounds, lights, or a drive mechanism, though the invention is not limited to controlling these functions.

[0039] It is believed that the disclosure set forth above may encompass multiple distinct inventions with independent utility. While each of these inventions has been disclosed in its preferred form, the specific embodiments thereof as disclosed and illustrated herein are not to be considered in a limiting sense as numerous variations are possible. The subject matter of the inventions includes all novel and non-obvious combinations and subcombinations of the various elements, features, functions and/or properties disclosed herein. Similarly, where the claims recite "a" or "a first" element or the equivalent thereof, such claims should be understood to include incorporation of one or more such elements, neither requiring nor excluding two or more such elements.

[0040] It is believed that the following claims particularly point out certain combinations and subcombinations that are directed to one of the disclosed inventions and are novel and non-obvious. Inventions embodied in other

combinations and subcombinations of features, functions, elements and/or properties may be claimed through amendment of the present claims or presentation of new claims in this or a related application. Such amended or new claims, whether they are directed to a different invention or directed to the same invention, whether different, broader, narrower or equal in scope to the original claims, are also regarded as included within the subject matter of the inventions of the present disclosure.